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INSTRUCTIONS FOR MOUNTING  
USING, AND CARING FOR  
**4.72-INCH GUN, ARMSTRONG**  
**45 CALIBER**

MOUNTED ON

**BARBETTE CARRIAGE, ARMSTRONG**

(FIVE PLATES)

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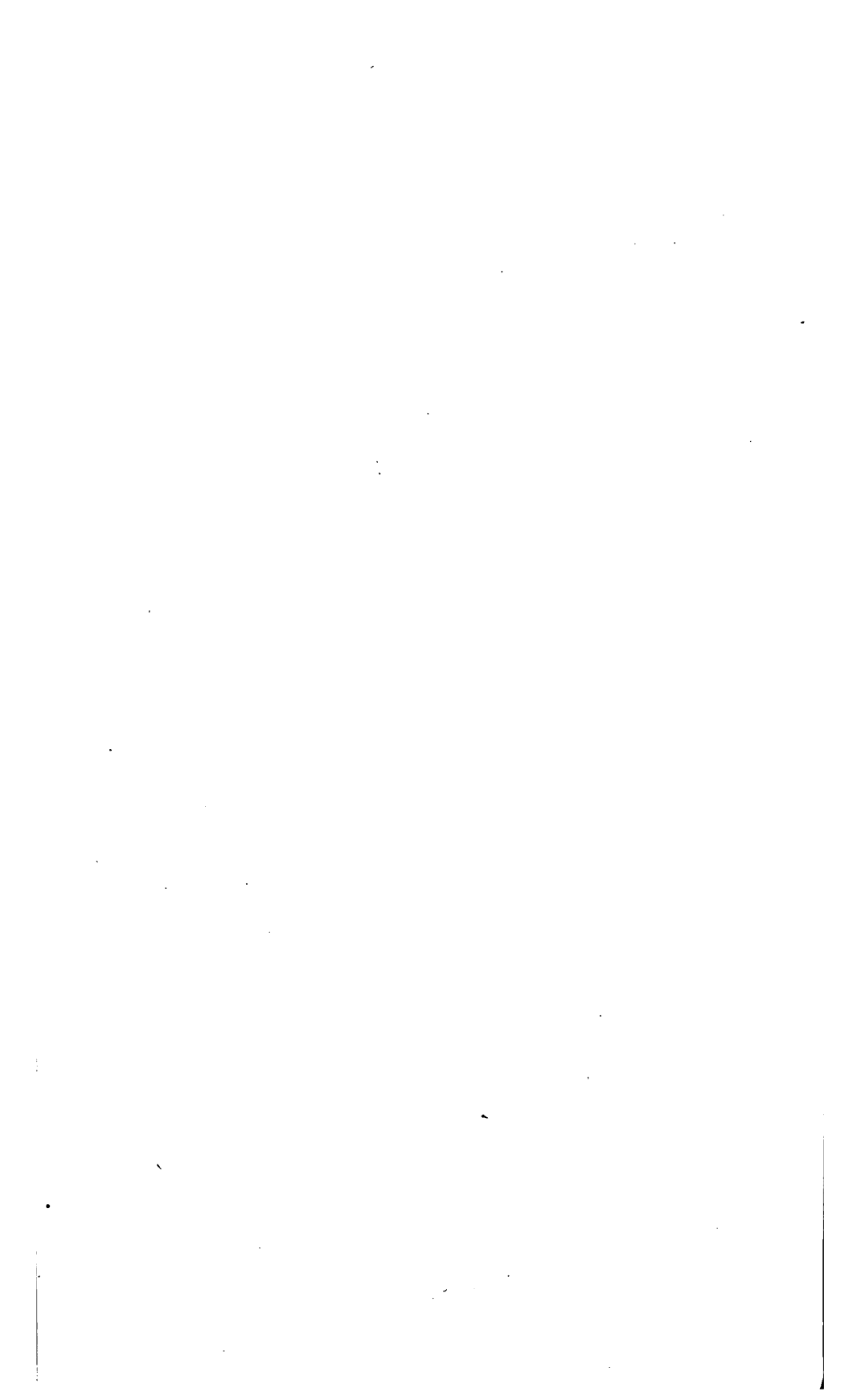
WAR DEPARTMENT,  
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**This Manual is published for the information and government of the Regular Army and Organized Militia of the United States.**

**By order of the Secretary of War:**

**WILLIAM CROZIER,**  
*Brigadier General, Chief of Ordnance.*

(3)



## INSTRUCTIONS

FOR

### 4.72-INCH GUN, ARMSTRONG,

MOUNTED ON

### BARBETTE CARRIAGE, ARMSTRONG.

(Five plates.)

(The points in *italics* are of importance, or concern the safety of the gun or carriage, and should be specially noted.)

## DESCRIPTION OF GUN.

(Plate I.)

---

Caliber.....	inches.....	4. 724
Weight.....	pounds.....	5, 958
Length:		
Bore.....	inches.....	207. 5
Rifling.....	do.....	179. 21
Chamber.....	do.....	26. 1
Total.....	do.....	212. 6
Over all (45 calibers).....	do.....	218. 4
Rifling, spiral right-hand twist, increasing from 0 at breech to 1 turn in 30 calibers at muzzle.		
Number of grooves.....		26

The gun is constructed entirely of steel and is designed for obtaining great rapidity of fire. For this purpose it is mounted in a special mounting and is not provided with trunnions, but is carried by a cradle, which encircles the gun, and in which it slides when recoiling. This cradle is provided with trunnions on which the gun and cradle are balanced. The breech of the gun is surrounded by a breech ring, which has a projecting arm on it for connecting the gun with the recoil cylinder, which forms part of the cradle. The mechanism for closing the breech is on the interrupted-screw system, so arranged that it can be quickly opened or closed by a single movement. The gun is provided with electrical firing gear, connected with an electrical pistol fixed to the mounting in a convenient place so that the man laying the gun can fire while looking over the sights. It is also provided with a percussion arrangement

for mechanical firing in case of failure of the electrical gear. The gun sights are fixed to the gun cradle and do not therefore recoil with the gun. The powder is contained in a metallic cartridge case, the base of the projectile resting against the front end of this case.

#### BREECH MECHANISM.

(Plate 1.)

The breech of the gun is closed by a breechblock formed in two steps, the front step being tapered and of less diameter than the rear; both steps have three portions of their thread removed, each one-sixth of a turn, the threads on one step standing opposite to the blank spaces on the other; this arrangement distributes the strain all round the circumference of the breechblock. The interior of the gun at the breech is prepared in a similar manner, and admits of the breechblock being swung into place and locked by a simple mechanism to be described.

The breechblock is supported by a block carrier, *P*, on which it is free to revolve through an angle of 60 degrees; the carrier is hinged to the right side of the breech ring, so that the block can swing clear of the breech opening for loading. The block is secured on the carrier by means of the stop bolt *D*. The breechblock is unscrewed and withdrawn from the gun by a single horizontal movement of the operating lever *L*, which is pivoted on the right side. A projecting pin, *P*<sup>1</sup>, is screwed into the rear face of the breechblock, and enters a traversing bushing, *P*<sup>2</sup>, in the sliding block *N*. This block slides in a seat in the carrier, and is connected to the hand-locking lever *L* by the link *N*<sup>1</sup>. When the breech is open, the block is prevented from turning on the carrier by a spring catch, *M*, on the carrier, which engages a notch, *M*<sup>1</sup>, in the block, as it is withdrawn from the gun; when closing the breech, the catch comes in contact with the face of the gun, thus releasing the block and leaving it free to be screwed home.

It is impossible to fire the gun until the breech is completely locked; this is insured by means of a safety gear, consisting of a safety lever, *F*, pivoted to the block carrier, *P*. The safety lever engages a lug, *R*, on the rear end of the firing pin, and is actuated by a plunger, *S*. The safety lever prevents the firing pin from touching the primer while the operating lever *L* is in the unlocked position.

The firing pin is secured in the carrier by the retaining nut *K*, and can be readily removed by slightly withdrawing it and turning the nut a quarter of a turn.

To assemble the firing pin, it is pushed into its place and the retaining nut turned to the right or left.

The upper end of the spindle *F*<sup>2</sup> is held in place by a screw countersunk in a housing, *H*. The spindle with its torsional spring and



spline key locks the operating handle when closed, and should the spline key be broken it will interfere only with this function but in no way affect the safety features of the mechanism.\*

The safety lever *F* which engages behind the retracting toe *R*, mounted on the rear end of the firing pin, is fulcrumed at its outer end to the block carrier *P* at a point *F*<sup>1</sup>. The safety lever controls the motion of the firing pin during the opening and closing of the block, and is operated by the intermediate, safety-lever plunger *S*, which passes through a hole in the block carrier and rests against the rear face of the breechblock. In opening the block the safety plunger is forced outward and to the rear by the screw motion of the block; it slowly forces out the safety lever, at the same time retracting the firing pin. The safety-lever plunger is made adjustable in length to provide for wear and control of the movement of the firing pin.

*This adjustment is to be so made and maintained that in closing the block the firing pin will begin to protrude from the face of the block when the operating lever is closed to a position about 1 to 3 inches short of that where the toe of the spindle *F*<sup>3</sup> enters its groove in the operating lever.*

The words "electric" and "percussion," with indicative arrows, are stamped on the rear face of the carrier to show the positions to which the retaining nut *K* is to be turned for firing.

For percussion firing the retaining nut *K* is revolved so that the firing trigger is in a horizontal position on the *right*. The loop of the trigger engages upon a knob of the lanyard connecting rod *J*<sup>1</sup>, which has at its outer end a loop in which the lanyard is to be habitually hooked. The object of this arrangement is to prevent the trigger from being used on the left side for percussion firing where no safety notch is provided. The right-hand position for percussion firing was selected in preference to the left-hand position, it being deemed most convenient for the service of the piece to pull the lanyard from the right.

A half-cock notch has been made in the right side of the firing-pin sleeve. In opening the block the firing pin is retracted by the safety lever to such an extent that the half-cock notch is held out a little beyond the trigger *J*. On closing the block, the firing pin is caught in the half-cock notch by the trigger and prevented from coming in contact with the primer. To fire the piece the pin will be drawn to a full cock by hand. This safety notch forms in itself a full safeguard against premature discharge for percussion firing.

For electric firing the retaining nut *K* is revolved so that the firing trigger is in a horizontal position on the *left*. The firing-cable

---

\*As originally constructed, the spindle *F*<sup>2</sup> with its levers was the safety lock for the firing pin as well as the lock for holding the operating lever closed.

attachment is on the right. A full-cock notch is made on this side of the firing-pin sleeve, although not needed for electric firing. No half-cock notch is made, as it would interfere with electric firing, necessitating the release of the firing trigger and freeing the firing pin after closing the block for every discharge. The full-cock notch is made on both sides of the firing-pin sleeve to avoid a possible accident, namely, the slipping of the firing pin from the hand if one attempted to cock it in the absence of any sear notch. By leaving the full-cock notch on this side it will also be possible to fire the piece by percussion with the firing trigger on the left. This is not intended and should be avoided unless the space in the emplacement is such as to necessitate pulling the lanyard from the left side. In such cases the safety feature for half cock is lost and reliance must be placed upon the safety lever. In closing the breech with the firing trigger to the left (where there is no half cock) the safety lever continues to restrain the firing pin, with slow motion, until the operating-lever handle has reached the nearly closed position, when the protruding firing pin comes in contact with the primer, after which the completion of the closure can cause no blow upon the primer.

The adjustment of the firing pin for point of first protrusion will be made with the firing trigger on the left and as follows:

The firing-pin sleeve nut must be screwed fully home in order to bring the opening in the sleeve opposite the firing-cable point which is screwed upon the retracting toe piece, and thus insure contact between the cable and the stem of the insulated firing pin. It is not permissible to adjust the protrusion of the firing pin by changing the position of the sleeve nut (brass), as this would destroy the cable contact. Next, keeping the breech open, revolve the block by the operating handle, at the same time placing a finger at the front of the firing pin. If the pin does not begin to protrude so that it would press upon the primer, if in place when the operating handle has reached the position already indicated, then adjust the length of the safety-lever plunger to regulate the protrusion of the firing pin as required. The safety-lever plunger is made in two parts, with a screw shank and locking nut for adjustment of length. The arm of the firing-pin sleeve cap can be used for turning the screw, while the safety lever itself, placed in the end slot of the pin, serves as a holder.

#### ELECTRICAL FIRING GEAR.

The electrical firing gear consists of the firing pistol, the battery box, cables, etc. (Plate V), a contact-pin plug bracketed to the gun, a contact surface block bracketed to the cradle, and an insulated firing pin, which is part of the gun.

The electrical power for firing is obtained from a battery of six O. K. dry cells No. 4, contained in the battery box in a bracket at

the left side of the carriage. One terminal of the battery is attached by a short cable to the pivot yoke as an earth connection. The other terminal of the battery is connected by means of a cable 24 inches long to the firing pistol, which is fastened to the maneuvering bracket. From the pistol the circuit is continued by means of a cable to a contact surface block. This is bracketed to the cradle in such a position that when the piece is "in battery" the contact pin, pressed out by a spring in the contact-pin plug attached to and moving with the gun, presses upon the contact surface of the plug before mentioned, thus making a connection for the next shot. From the contact-pin plug the firing-pin cable extends through a locking-pin hinge of the breech mechanism to the firing pin. The circuit is then completed through the firing-pin, primer, and gun to the battery.

The firing pistol contains a "buzzer" which indicates by its sound when the circuit is closed. This is effected by the current running through the coils of an electro-magnet, the resistance of which is so great as to reduce the current below that necessary to fire the primer. By pulling the trigger this resistance is cut out and the current is then great enough to fire the primer.

An alternative electrical firing attachment is also provided. It consists of a battery of six O. K. No. 4 dry cells carried in a bracket on the right side of the carriage. One terminal of the battery is grounded on the carriage; the other terminal is directly connected with the firing pin through the alternative firing key and cables.

The alternative key consists of a tube into one end of which a cable end is coupled fast. The cable entering the other end is secured to a plunger which is held out by a coiled spring. When grasped in the hand with the thumb on the plunger end, the cable ends may be pushed together, completing the circuit. To guard against premature discharge of the piece, a split key is wired to this firing key to prevent forward movement of the plunger, and should be kept pushed across the plunger head until the piece is about to be fired.

Before connecting the alternative cable to the battery and firing pin the other cables which may be connected to the firing pin should be removed.

#### PERCUSSION FIRING GEAR.

(Plate I.)

The percussion firing gear is fitted to the retaining nut *K*, and consists of a spring trigger, *J*, with a loop to receive the knob on the lanyard connecting rod *J*<sup>1</sup>.

To fire by percussion the firing pin or needle *E* is pulled by hand to the rear until it is caught by the trigger, which retains it until the latter is displaced by a pull on the lanyard attached to the loop on the end of the lanyard connecting rod. This leaves the firing needle free to travel forward and strike the primer.

## CARTRIDGE EXTRACTOR.

The cartridge is started by an extractor which has only sufficient motion to insure its being free for the remainder of the extraction, the conical shape of the cartridge case and chamber rendering a small motion sufficient for this purpose. The cartridge is then completely withdrawn by means of a hand extractor which readily fits over the flange of the cartridge case.

The mechanical extractor is worked by the carrier in opening the breech screw. It consists of a rod passing through one side of the gun and fitting into the groove for the rim of the cartridge case in such a manner that when it is turned about its own axis the fitted part acts as a lever and presses the cartridges to the rear.

The extractor is brought back into its place as the breech is closed by means of a strong helical spring outside the gun. This spring also serves as a buffer to prevent the breech screw and carrier being swung too violently round. The extractor is fitted to the right side, so that it is out of the way of loading or damage from a projectile when the latter is being entered into the gun.

## CARTRIDGE CASE.

(Plate III.)

The cartridge case is made of brass, to the form shown on drawing. It is screw-threaded at the base for the reception of the primer adapter (the cartridge cases of Frankford Arsenal manufacture are not provided with an adapter); its mouth is closed with a lid, which is secured by three projections formed around the mouth, being turned over three corresponding notches cut round the flange of the lid. The joint round the lid is sealed by cement, to render the case perfectly air-tight.

The primers used in these cases are of Frankford design and manufacture and are known as the 110-grain electric and 110-percussion primers.

A saluting case is provided for this gun containing a charge of 5 pounds of black powder. A percussion primer only is used in the saluting cases. It is of Frankford Arsenal design and manufacture and is known as "saluting primer, percussion." A full description and drawings of the primers used in both the saluting and service cases will be found in pamphlet numbered 1881, published by the Ordnance Department.

## PROJECTILES.

## SHELL.

Common cast iron: Sand filled for target practice.

Common steel	} Prepared to receive high explosive charge and
Strong-headed steel	

medium caliber base detonating fuze.

None of these projectiles are provided with caps.

## SHRAPNEL FUSED.

#### 4.72-INCH GUN, 45 CALS. INSTRUCTIONS FOR FILLING AND MAKING UP CARTRIDGES.

After inserting the primer in the head of the case, weigh out the igniting charge ( $1\frac{1}{4}$  ounces of black powder), fill the bag, choke it, and stitch it into the inside of the bottom of the cartridge bag so that the shalloon end of the bag is next to the primer, and thus cover the space occupied by the netting.

Weigh out the propelling charge, 10 pounds 8 ounces of nitro-cellulose powder, and put it into the cartridge bag. Choke the bag and tie up the braids so as to make a firm cartridge.

All cartridges should be carefully examined and gauged as to length and diameter.

The bag is inserted into the mouth of the case and gently dropped down against the primer (the end with igniting charge downward).

Coat the edges of the lid with Pettman's cement or equal, insert it in the mouth of the case (so that the portions where the flange is cut away are opposite the tongues), and drive home with a few light taps from a wooden mallet until the flange of the lid is on the edge of the cartridge case; the tongues of metal are then turned over the edge of the lid and hammered closely down with a hammer.

#### INSTRUCTIONS FOR PREPARING AND FIXING FUZES.

##### COMBINED TIME AND PERCUSSION.

(Plate III.)

Intended for use with shrapnel.

The exterior of the cylindrical part of the fuze body is marked in centimeters and tenths of a centimeter.

*To set the fuze.*—Free the nut *C* by hand, or by the key, turn the cover *D* till the mark on it is opposite the point on the scale required, then tighten down the nut *C* very firmly. Should any alteration be required after the fuze is set, it is easily made by freeing the nut, turning the cover to the point desired, and tightening the nut firmly down again. Care must be taken that the setting of the fuze is not altered in the operation.

The shrapnel is then brought up to the gun, and when it is on the point of being loaded the two safety pins must be withdrawn.

NOTE.—If it be desired that the percussion arrangement alone should act, the arrow on the collar must be set directly opposite the arrow on the fuze body.

##### BASE CONCUSSION.

(Plate III.)

For use with common and strong-headed shell, intended to burst on impact or light graze.

This fuze is simply screwed firmly into the fuze hole, by means of the key, and the lead cap pressed into the recess around the fuze head.

#### GENERAL INSTRUCTIONS FOR GUNS.

The bores of guns from which practice is carried on should be kept slightly oiled to prevent rusting. At the close of each day's practice they should accordingly be washed and slightly depressed, and when dry, oiled with a sponge, the muzzles being then closed with tompions.

N. B.—When guns are not likely to be used for some length of time the sights and firing pin should be removed and kept in store, the holes in the guns and mountings being filled with a plug of greased tow, to keep out water and dirt. These plugs can be readily removed when it is required to fit the sights, etc., to the guns and mountings, and particular attention should be paid to the prevention of rust or grit accumulating in the sight recesses.

The sights and other fittings should be kept clean, free from grit, and oiled; the sliding leaf and other working parts should have free play.

The exposed portions of the sights are bronzed if made of gun metal and blued if of steel. This is done to preserve them from corrosion, and on no account are these parts to be burnished or cleaned in such a manner as to remove the bronzing or bluing.

The bore and all working parts must at all times be kept slightly oiled and perfectly free from rust.

During firing, the male and female screws of the breech must be kept perfectly clean, free from dirt, and well oiled.

The officer in charge of the gun must always see that all gear is in good working order, and that the breech is properly closed and the locking lever is in its locked position before firing.

No. 51674.

#### 4.72-INCH RAPID-FIRE GUN, 45 CALS.

Charge (nitrocellulose) .....	10.5 lbs.
Projectile .....	45 lbs.
Muzzle velocity .....	2,570 ft. per sec.
Total energy .....	2,061 ft. tons.
Jump .....	+ 3.5 min.
Penetration, W. I. plate:	
At muzzle .....	15.3 inches.
At 1,000 yards .....	10.8 inches.
At 2,000 yards .....	7.8 inches.
At 3,000 yards .....	5.8 inches.

Range table for 4.72-inch gun, 45 cal.

Range.	Elevation.	Slope of fall.	Remaining velocity.	Five minutes' elevation will alter range by—	Five minutes will alter point of impact vertically or laterally at each range.	Length of fuze.		Time of flight.
						Medium.	Small.	
<i>Yards.</i>	<i>Deg. Min.</i>	<i>1 inch.</i>	<i>F. S.</i>	<i>Yards.</i>	<i>Yards.</i>	<i>Cm.</i>	<i>Cm.</i>	<i>Seconds.</i>
200	0 3	573	2,459	183	0.29	.....	.....	0.22
300	0 6	429	2,411	179	.43	.....	.....	.34
400	0 9	312	2,363	175	.58	.....	.....	.47
500	0 12	286	2,315	171	.72	1.19	.....	.60
600	0 16	191	2,268	167	.87	1.44	.....	.73
700	0 19	163	2,221	163	1.01	1.69	2.89	.86
800	0 23	143	2,176	159	1.16	1.94	3.09	1.00
900	0 36	122	2,132	155	1.31	2.19	3.29	1.14
1,000	0 30	104	2,089	152	1.45	2.44	3.48	1.28
1,100	0 33	95	2,047	149	1.60	2.69	3.67	1.43
1,200	0 37	82	2,005	146	1.74	2.94	3.86	1.58
1,300	0 40	72	1,964	142	1.89	3.19	4.05	1.73
1,400	0 44	65	1,924	139	2.03	3.44	4.23	1.88
1,500	0 48	59	1,885	135	2.18	3.69	4.41	2.04
1,600	0 52	54	1,846	132	2.32	3.94	4.59	2.20
1,700	0 56	49	1,808	129	2.47	4.19	4.77	2.37
1,800	1 0	45	1,771	126	2.61	4.43	4.96	2.54
1,900	1 4	41	1,736	123	2.76	4.67	5.14	2.71
2,000	1 8	38	1,702	120	2.91	4.92	5.33	2.89
2,100	1 12	35	1,669	117	3.05	5.17	5.52	3.08
2,200	1 17	32	1,637	114	3.20	5.42	5.72	3.27
2,300	1 21	30	1,606	111	3.34	5.67	5.92	3.46
2,400	1 26	28	1,576	108	3.49	5.92	6.12	3.66
2,500	1 30	26	1,574	105	3.63	6.17	6.32	3.86
2,600	1 35	25	1,518	102	3.78	6.42	6.52	4.06
2,700	1 40	24	1,490	100	3.92	6.67	6.73	4.26
2,800	1 45	23	1,462	97	4.07	6.92	6.94	4.46
2,900	1 51	22	1,435	94	4.21	7.17	7.15	4.67
3,000	1 56	21	1,409	92	4.36	7.42	7.36	4.88
3,100	2 2	20	1,384	90	4.51	7.67	7.58	5.09
3,200	2 8	19	1,360	88	4.65	7.92	7.81	5.32
3,300	2 14	18	1,336	86	4.80	8.18	8.04	5.55
3,400	2 20	17	1,312	83	4.94	8.43	8.27	5.78
3,500	2 26	16	1,288	81	5.09	8.68	8.50	6.01
3,600	2 33	15	1,266	79	5.23	8.93	8.74	6.24
3,700	2 39	14	1,244	77	5.38	9.18	8.98	6.48
3,800	2 46	13	1,223	75	5.52	9.44	9.23	6.73
3,900	2 53	12	1,202	73	5.67	9.69	9.48	6.98
4,000	3 0	12	1,182	71	5.81	9.94	9.73	7.23
4,100	3 7	11	1,162	69	5.96	10.19	9.98	7.48
4,200	3 15	11	1,143	67	6.11	10.43	.....	7.74
4,300	3 23	10	1,125	65	6.25	10.67	.....	8.00
4,400	3 31	10	1,108	64	6.40	10.91	.....	8.26
4,500	3 39	9	1,091	62	6.54	11.15	.....	8.52
4,600	3 48	9	1,074	61	6.69	11.38	.....	8.79
4,700	3 57	9	1,058	59	6.83	11.60	.....	9.06
4,800	4 6	8	1,042	58	6.98	11.81	.....	9.34
4,900	4 15	8	1,027	56	7.13	.....	.....	9.62
5,000	4 25	8	1,012	55	7.27	.....	.....	9.91

Range table for 4.72-inch gun, 45 cals.—Continued.

Range.	Elevation.	Slope of fall.	Remaining velocity.	Five minutes' elevation will alter range by—	Five minutes will alter point of impact vertically or laterally at each range.	Length of fuze.		Time of flight.
						Medium.	Small.	
<i>Yards.</i>	<i>Deg. Min.</i>	<i>1 inch.</i>	<i>F. S.</i>	<i>Yards</i>	<i>Yards.</i>	<i>Cm.</i>	<i>Cm.</i>	<i>Seconds.</i>
5,100	4 34	8	999	54	7.42	.....	.....	10.20
5,200	4 44	7	984	53	7.56	.....	.....	10.49
5,300	4 54	7	971	52	7.71	.....	.....	10.78
5,400	5 4	7	958	51	7.85	.....	.....	11.07
5,500	5 14	7	945	49	8.00	.....	.....	11.38
5,600	5 25	6	933	48	8.14	.....	.....	11.69
5,700	5 36	6	921	47	8.29	.....	.....	12.00
5,800	5 47	6	909	46	8.43	.....	.....	12.32
5,900	5 58	6	898	45	8.58	.....	.....	12.64
6,000	6 10	6	887	44	8.73	.....	.....	12.97
6,100	6 22	5	876	44	8.87	.....	.....	13.30
6,200	6 34	5	866	43	9.01	.....	.....	13.63
6,300	6 46	5	856	42	9.16	.....	.....	13.96
6,400	6 58	5	846	41	9.30	.....	.....	14.30
6,500	7 10	5	838	41	9.45	.....	.....	14.64
6,600	7 23	5	829	40	9.60	.....	.....	14.98
6,700	7 36	4	820	39	9.74	.....	.....	15.33
6,800	7 49	4	811	39	9.89	.....	.....	15.69
6,900	8 2	4	802	38	10.03	.....	.....	16.05
7,000	8 16	4	794	37	10.18	.....	.....	16.38
7,100	8 30	4	786	37	10.32	.....	.....	16.74
7,200	8 44	4	778	36	10.46	.....	.....	17.11
7,300	8 58	4	771	35	10.60	.....	.....	17.49
7,400	9 13	4	763	35	10.75	.....	.....	17.87
7,500	9 27	3	755	35	10.89	.....	.....	18.26
7,600	9 42	3	747	34	11.04	.....	.....	18.65
7,700	9 56	3	739	34	11.19	.....	.....	19.04
7,800	10 11	3	732	34	11.34	.....	.....	19.43
7,900	10 26	3	725	33	11.48	.....	.....	19.82
8,000	10 41	3	718	33	11.63	.....	.....	20.19
8,100	10 57	3	712	33	11.77	.....	.....	20.58
8,200	11 13	3	706	32	11.92	.....	.....	20.97
8,300	11 29	3	701	32	12.07	.....	.....	21.36
8,400	11 45	3	696	32	12.22	.....	.....	21.75
8,500	12 2	3	691	32	12.36	.....	.....	22.14
8,600	12 18	3	686	31	12.50	.....	.....	22.53
8,700	12 35	3	681	31	12.65	.....	.....	22.92
8,800	12 51	2	677	31	12.80	.....	.....	23.31
8,900	13 8	2	673	30	12.94	.....	.....	23.90
9,000	13 24	2	669	30	13.08	.....	.....	24.09
9,100	13 41	2	665	30	13.23	.....	.....	24.38
9,200	13 57	2	661	30	13.37	.....	.....	24.79
9,300	14 14	2	657	30	13.52	.....	.....	25.16
9,400	14 31	2	653	30	13.66	.....	.....	25.56
9,500	14 48	2	649	29	13.81	.....	.....	25.96
9,600	15 5	2	645	29	13.96	.....	.....	.....



## DESCRIPTION OF CARRIAGE.

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### INSTRUCTIONS FOR MOUNTING, USING, AND CARING FOR 4.72-INCH BARBETTE CARRIAGES, ARMSTRONG.

(Pl. II.)

#### WEIGHTS.

	Pounds.
Cradle .....	1, 428
Yoke .....	1, 564
Outer shield .....	8, 645
Inner shield .....	295
Pedestal .....	1, 456
Total .....	13, 388

This carriage is of the center-pivot barbette type. The principal parts are the pedestal, pivot yoke, cradle, elevating and traversing gearing, shields, sights, and the electrical attachments.

#### PEDESTAL.

The pedestal forms vertical and step bearings, in which the pivot yoke rotates. The yoke rests upon a ball thrust bearing in the step. The upper portion of the pedestal is finished to form a bearing for the worm wheel of the traversing gear. The interior of the worm wheel and a bushing in the step form the vertical bearings for the pivot yoke.

The pedestal is secured to the foundation by eighteen 1½-inch bolts. Two handholes on the side of the pedestal gives means for cleaning, oiling, etc.; they are provided with covers.

A friction clamp is fitted on the rear side of the pedestal which when loosened permits rapid rotation. It consists of a clamp screw with handle, a pair of Belleville spring washers, and a gun-metal friction block. On tightening the clamp the friction block is pressed against the worm wheel of the training gear by the spring washers so that it is held frictionally in the pedestal, permitting rotation by the worm-and hand wheels.

## PIVOT YOKE.

The pivot is a Y-shaped piece of forged steel. Its lower end rests on the balls of the thrust bearing, and the lower end of the stem is machined to form a bearing in the step. The upper part of the stem is turned to form a bearing inside the traversing worm wheel. Trunnion bearings for the cradle are formed at the upper ends of the pivot yoke. They are provided with cap squares which slip into under-cut grooves from the outside.

The cap squares are held in place by pins inserted from the top.

A small inner shield is bolted to the front of the pivot yoke under the gun; it serves to protect the working parts from such projectiles as might pass through the port of the curved shield.

A bronze bracket is bolted to the left side of the yoke to support and provide a bearing for the lower end of the traversing shaft and its worm. A heavy steel maneuvering arm is bolted to the left side of the pivot yoke. It forms a support for the elevating and traversing gearing, including the shoulder rest and firing pistol. A light steel bracket is attached below, near the end of this arm, and carries the battery boxes of the electric firing attachment. A light steel arm is also bolted to the right side of the pivot yoke and forms a support for the battery boxes for the night sights and the alternative firing gear.

## CRADLE.

The cradle, A, is of bronze and includes the large cylinder through which the gun recoils, the hydraulic cylinder, the spring box, the trunnions, and the reserve oil tank.

The large cylinder is slotted along its upper and lower elements for keys which are machined on the gun. These serve to guide the gun during recoil.

The hydraulic cylinder is directly under the gun. It is provided with a forged-steel liner and head in one piece. This liner is inserted in the cylinder of the cradle from the rear and secured thereto by threads cut on its front end. The steel liner is finished flush with the rear face of the cylinder and is threaded to take the rear cylinder head.

The recoil cylinder is provided with a piston rod and piston of steel, forged in one piece. The piston rod passes through the rear cylinder head and through a lug on the gun, where it is secured by a nut and pin. A check nut is screwed on the rod in front of the recoil lug; it is provided with a set screw to lock it in place. The seat for this nut is countersunk in the front face of the recoil lug. The piston head is slotted for one throttling bar which is secured to the bottom of the liner by a bolt through the bottom of the cylin-

der. The piston head and rod are bored to form the female portion of the counter-recoil buffer. The piston head has a small band of bronze dovetailed into its circumference to provide a suitable bearing against the steel liner. The cylinder permits a movement of the piston of 12 inches. The rear cylinder head is made of forged steel. A leather washer on its front face prevents leakage by its threads. An intermediate stuffing-box bushing forced in place forms a seat for a cup-leather packing about the piston rod. It is secured in place by a bronze bushing screwed into the front end of the cylinder head. The rear face of the stuffing-box bushing forms a seat for the Garlock packing which is secured in place by the gland in rear. The recoil cylinder is provided with a drain hole at the bottom and an air hole at the right rear on top.

The reserve oil tank is a cavity or receptacle cast on the right-hand side of the cradle just above and to the right of the recoil cylinder. It is connected to the rear cylinder by a  $\frac{3}{8}$ -inch hole which enters the recoil cylinder at  $1\frac{1}{2}$  inches from its front end. Its function is to insure that the recoil cylinder is always full of oil.

The reserve oil tank has a handhole on the side, closed by a screw plug which may be removed for cleaning purposes; and a filling hole is provided on top.

#### INSTRUCTIONS FOR FILLING THE RECOIL CYLINDER.

*Depress the gun and take out the filling and air plug on the right side of the carriage. Fill through the filling hole in the reserve tank until the oil overflows through the air hole; replace the air plug and fill in until the oil overflows at the filling hole, then replace the filling plug.*

*About 14 pints of hydroline oil, specific gravity 0.85, are required to fill the cylinder and reserve oil tank.*

The spring box is under the front part of the cradle. It contains a column of two spiral springs assembled end to end and bolted together under an initial compression such that the assembled length is  $29\frac{3}{4}$  inches. Two spring supports bolted across the bottom of the spring box hold the column in position.

A spring yoke bears across the front end of the spring column and is secured to the recoil lug on the gun by two spring rods. These rods give the proper compression on the springs when they are screwed into the spring yoke as far as they will go.

The cradle is provided with trunnions so placed as to be at the center of gravity of the system when the gun with projectile in place is in the firing position. These trunnions rest in their beds in the pivot yoke and are secured in place by cap squares. An elevating rack is bolted to the left side of the cradle and an extension in rear forms

a place of attachment for the shoulder guard. There is also an arm bolted to the left side of the cradle to carry the sight bar.

#### ACTION OF THE SYSTEM.

Upon firing, the gun moves about 12 inches to the rear, carrying with it the piston and spring rods and compressing the recoil springs. The energy of recoil is in a measure taken up in compressing the counter-recoil springs, but by far the greater portion is taken up by the resistance the oil offers when it is forced through the slot in the piston head, and also the small clearance around the piston head as the latter moves to the rear. In any hydraulic brake the resistance is greater as the velocity of the piston in the cylinder is greater, and as the openings for the passage of the liquid are less. The velocity of retarded recoil of the gun and the piston being variable and a constant resistance being desired, the orifices are varied in such manner that the relation between the velocity and the area of the orifices is at all times such as to give a nearly constant resistance. In this case the throttling bar is of constant width with only sufficient lateral clearance in the slot of the piston for working movement, and is of varying depth, the profile being so designed that the area of the orifice (the portion of the slot not filled by the bar) for the escape of the oil past the piston increases from the beginning of the motion up to the point where the velocity of retarded recoil of the gun is greatest. Beyond this point the velocity of retarded recoil of the gun is continually decreasing and the area of the orifice decreases continually until it becomes zero at the end of recoil. The area of the orifice has at each point such a relation to the velocity of retarded recoil of the gun at that point as to give nearly a constant resistance to the motion of the gun. This results in a nearly constant fluid pressure in the cylinder.

When the gun has been brought to rest it is carried forward to the firing position by the counter-recoil springs, their pressure being brought to bear on the recoil lug of the gun through the medium of the spring yoke and the spring rods.

When the gun is returning to the firing position the oil caught in front end of the piston can escape only by a small and decreasing clearance around the counter-recoil buffer. This serves to bring the gun to rest without shock.

#### TRAVERSING GEAR.

The traversing gear consists of a bronze wormwheel with a hub on the underside, which fits into the pedestal, and forms a bearing for the pivot yoke. A worm driven by a handwheel, *K*, and con-

necting shaft gears with the wormwheel. The traversing shaft has a rear bearing in a bracket bolted to the maneuvering arm, and a front bearing in a bracket secured to the pivot yoke. On tightening the friction clamp on the pedestal the worm wheel is held stationary in the pedestal, so that on turning the worm the mounting revolves, the pivot yoke turning in its bearing in the worm wheel. On slackening the clamp, the mounting can be revolved by means of the shoulder piece which is fitted to support the man laying the gun, the wormwheel going around with the mounting, turning on its bearing on the pedestal.

#### THE ELEVATING GEAR.

The elevating gear is carried by a gun-metal bracket attached to the maneuvering arm of the carriage. It is actuated by a hand wheel "L," which is placed in a convenient position to be worked by a man laying the gun. The hand wheel drives by means of a pair of miter gears and a worm which works the wormwheel.

On the inner end of the spindle carrying this wormwheel a pinion is fixed which gears with the elevating arc attached to the cradle.

The elevating gear is provided with a frictional driving arrangement, as follows:

The boss of the wormwheel is hollow and contains a series of friction rings, part of which are of steel, and are keyed to and turn with the shaft; while the remaining rings are of manganese bronze and are keyed to and turn with the wormwheel. These friction rings are placed alternately and are pressed together by means of a spring-steel washer and two nuts on the outer end of the shaft. By adjusting these nuts the rings are pressed together to produce the requisite friction, preventing the gun running down at extreme recoil, but at the same time allows the gun to move slightly when firing without straining or giving motion to the whole of the gearing. This nut is to be tightened if the gun runs down when fired, but not sufficiently to prevent any slipping whatever.

#### SHIELDS.

The mounting is fitted for its own protection and that of the men working the gun with an outer circular shield of steel plate  $4\frac{1}{2}$  inches thick and an inner flat vertical shield of steel 3 inches thick, both of which are provided with apertures for laying the gun. The outer shield is fitted with side wings of steel plate 2 inches thick and a flat roof 1 inch thick. The circular shield is supported by, and secured to, the pivot yoke by means of heavy spring fastenings bolted to it and to the pivot yoke.

## THE SIGHTS.

The sights are of the bar and drum pattern and consist of a carrier, a sight bar with rack and front and rear sights, a worm-wheel, pinion, and a drum with a graduated ring attached to its circumference. The sight automatically corrects for normal or rotational drift.

The carrier is fixed to two bosses on the cradle bracket by means of two T-headed bolts. The rear T bolt has an eccentric bearing which permits an adjustment of the line of sight at zero elevation to agree with the axis of the gun. A set screw is provided to maintain the adjustment when made. The fore sight is furnished with an upright blade terminating with a spherical head. The rear sight consists of an H-shaped piece secured to a sliding bar which has a lateral movement of 2 degrees each side of the center. The lateral motion is given by a screw which projects at each end beyond the slide to receive the knurled thumb piece. The slide cover of German silver is attached by four screws to the rear face of the slide. The deflection scale stamped on it is graduated to 10 minutes.

There are two designs of range drums in service. Both permit of the adjustment of the scale to agree with the zero of the rack. In the first type the scale is secured to the outside of the drum by three screws. If these screws are loosened the scale can be slipped around so that its zero agrees with that of the rack when run down. It is secured in place by tightening the screws. In the second form the drum, with the scale permanently attached thereto, is held frictionally between two plates which turn with the shaft. By loosening three screws these friction plates permit the drum to be turned sufficiently to effect the adjustment required.

The range scale on the drum is graduated in yards for an initial velocity of 2,570 feet a second. This is the velocity for full charge smokeless powder. Some of the range scales are also graduated for an initial velocity of 1,786 feet a second, which is the velocity given by the pebble powder.

The scale on the rack is graduated to 10 minutes. Both the rack and the drum are actuated by means of a handwheel working a wormwheel, shaft, and pinion.

## THE NIGHT SIGHTS.

The night sights (Plate IV) consist of two small fittings readily attached to the day sights. These fittings contain small electric lamps. The rays from that in the front sight illuminate a small glass lens which appears as a small bead of light. That in the rear sight illuminates the H-shaped fitting which with the bead of the

front fitting forms the line of sight. The rear lamp can be readily removed from its fitting and used for the purpose of setting the range scale, etc., on the sight bars while adjusting the height of the sights.

The electrical power for the night sights is obtained from ten No. 4 O. K. cells carried in a battery box on the right side of the carriage. Five of these cells are connected in series with each light, and a rheostat is provided for each so that the intensity of each light may be regulated.

It is found in practice that the smallest quantity of light compatible with distinguishing the sight is best, as the eye is not dazzled thereby.

On putting the lights into action, the operator should see that the resistance pointers are at "off" before attaching the cables and plug connections from the lights to save running down the battery or burning out the lights. The pointers of the rheostats should then be moved round in the direction of the arrow until the desired brilliancy is attained. During any interval in firing the rheostat pointer should be moved to "off" and upon "cease firing" the cables and plug connections should be removed in order to avoid needlessly running down the battery.

#### CARE OF THE CARRIAGE.

When using the carriage all bearing parts should be thoroughly cleaned and well lubricated. *It is especially required that the carriage, as well as the gun, be kept free from rust.* If this be allowed to accumulate its removal from all bearing parts, and especially the piston rod, requires care in order that the clearances may not be unduly increased. The use of sandpaper in removing rust from bearing surfaces is forbidden, and emery cloth No. 1, being coarse enough for ordinary rusting, should be used, the rust being softened, if necessary, by kerosene.

Oil holes are provided for all bearing parts except the bearing of the pivot yoke in the pivot socket. Two handholes with cover plates are provided in the pedestal to permit oiling this part. The oil holes must be cleaned out frequently to keep them free from sand and grit and will be habitually kept closed except when in the act of oiling. *Before oiling at any oil hole, wipe off carefully any dirt or grit near the opening that might be carried down into the bearing by the oil.*

For further information regarding paints, oils, cleaning materials, and methods of using same, see Ordnance Department Pamphlet, Form 1869. Annual allowances will also be found in this pamphlet.

The carriage all being mounted, the following description is intended to serve as a guide in dismantling the carriage only so far as is necessary to clean the otherwise inaccessible parts, i. e., the gun bearing in the cradle, the cradle trunnion bearings, and the pivot-yoke bearing in the pedestal.

It will be found desirable to dismount the carriage to this degree about once each year.

The operation requires the usual implements for mechanical maneuvers found at forts; a garrison gin or a pair of shears capable of lifting 7,500 pounds will be found desirable. In handling the carriage no parts should be directly struck with a steel hammer or sledge; soft-metal drifts or copper or lead hammers should be used. Care should be exercised that edges or finished surfaces do not become upset or burred.

When two bearing surfaces are brought together it is especially necessary that both parts should be absolutely clean and smooth and well lubricated.

The following description gives a statement of the order in which the work should be done rather than the details of the operation:

Elevate the gun about 5 degrees and remove the oil from the recoil cylinder and reserve oil tank through the drain hole in the bottom of the cylinder.

Place the gun at zero elevation and traverse the carriage so that the gun can be run to the rear upon the parapet. Place blocking under the rear end of the cradle and build a run of blocking and planking from the cradle to the parapet sufficiently strong to support the gun.

Remove the spring rods, the piston-rod nut, and split pin, and slide the gun to the rear about 24 inches. Place a piece of 3-inch plank about 24 inches long and 12 inches wide under the gun just forward of the recoil lug, and place rollers on the run under the plank. Shift the weight of the gun from the cradle to the plank. A check should be placed on the plank on each side of the gun to prevent rolling. Build another run in front of the shield high enough so that a roller placed thereon will support the muzzle of the gun.

Carry the gun to the rear by rolling it on the rolls, taking care to carry it straight, so that it will not strike and mar the sides of the cradle. Shift the rolls when necessary and continue until the gun rests on the parapet.

Remove the rear cylinder head and piston from the cylinder. Place a 2-inch plank on blocking as far forward under the cradle as is possible. Remove the cap squares from the trunnions, and by



means of a wooden handspike through the port of the shield lift the cradle clear of the trunnion bearings; block it in this position on the plank, and by means of a rope slide it on the plank to the rear and out of the way.

Erect the garrison gin over the shield and life shield and pivot yoke together clear of the pedestal and block them in this position.

Remove the traversing wormwheel from the pedestal. With a  $\frac{5}{8}$ -inch bolt screwed into the center of the ball bearing, lift it from its seat in the pedestal, and remove the loose bronze liner.

Clean thoroughly all parts, slushing out the recoil cylinder and reserve oil tank with kerosene oil, using the hand pump furnished for that purpose; wipe all parts clean with waste and lubricate well with synovial oil before reassembling.

With a machinist's level try the top of the pedestal to ascertain if it is level at all points. If it is found to be out of level, slack the nuts on the foundation bolts and drive in the wedges on the low sides until the top shows level; then tighten down the foundation bolts evenly and note if any change in level takes place. If there is, the bolts should be slacked again and the wedges driven at the proper points. RegROUT the pedestal in this position.

Remount the parts in the reverse order and examine carefully to see that all parts are properly assembled.

Fill recoil cylinder and reserve oil tank.

The oil in the recoil cylinder and reserve tank should be examined about once in three months, and the cylinder and tank should be cleaned about once in six months.

*The following methods should be pursued unless the carriage is to be dismantled:*

Elevate the gun about 5 degrees and remove the oil from the recoil cylinder and reserve tank through the drain hole in the bottom of the cylinder.

Place the gun at zero elevation and place blocking under the rear end of the cradle. Remove the spring rods and by pressure on the muzzle move the gun to the rear as far as the piston head will permit.

Open the breech and place wooden handspike in the bore of the gun; make a rope fast around the protecting end of the handspike and carry it forward over the top of the gun and take a turn around a handspike placed across the opening in the shield. With a spanner wrench unscrew the gland and cylinder head, then slide the gun to the rear until the rear side of the recoil band is about 19 inches in rear of the cradle, releasing the rope little by little, so as to have the gun always under control.

Remove the tank-cleaning-hole plug from the reserve oil tank and clean the tank by flushing it with kerosene oil by means of the hand pump. Clean the recoil cylinder in the same manner, wiping both

dry with cotton waste. Clean also the piston head, piston rod, and cylinder head.

Slide the gun forward gently by pushing on the breech, care being taken that the slot in the piston head is in line with the throttling bar in the cylinder. When the piston rod has entered far enough, screw the cylinder head home with the spanner wrench, then slide the gun forward as far as possible and assemble the spring rods.

Fill reserve oil tank and cylinder.

LIST OF ARTICLES PACKED IN THE ARMAMENT CHEST FOR 4.72-INCH GUN, ARMSTRONG,  
AND BARBETTE CARRIAGE, ARMSTRONG.

[NOTE.—All articles marked thus (\*) are carried loose in the chest.]

For gun:

- 1 adapter wrench.
- 1 wrench and screw-driver for breechblock.
- 1 combined tit wrench and screw-driver for breech-cushion stops.
- 1 cartridge-case clip.
- 1 quire emery cloth, No. 00.
- 1 drift, 2.7 long.
- 1 drift 5 long.
- 1 drift, 7.25 long.
- 1 bronze drift for removing hinge pin.
- 3 files, pillar, No. 6, 6-inch.
- 3 files, three-cornered, No. 4, 6-inch.
- 3 files, half-round, smooth, 8-inch.
- 3 files, round, smooth, 8-inch.
- 1 file, flat, dead smooth, 8-inch.
- 1 file, round, second cut, 8-inch.
- 1 file, half-round, smooth, 8-inch.
- 1 file, three-cornered, 8-inch.
- 1 hand extractor for cartridge case.
- 1 boiler maker's hammer.
- 1 copper hammer.
- \* 1 lanyard and handle.
- 1 hand mallet.
- 1 long-handled mallet.
- 1 pair cutting pliers, 7-inch.
- \* 1 gunner's pouch.
- 1 metal scraper.
- 1 screw-driver, commercial, 5-inch blade.
- \* 1 pair gunner's sleeves.
- 1 spanner wrench for firing mechanism and cable couplings.
- \* 3 wagon sponges.
- \* 4 balls twine, assorted.
- \* 10 pounds cotton waste.
- \* 2 pounds copper wire, No. 12.
- \* 2 pounds copper wire, No. 16.
- 1 monkey wrench, 18-inch.
- 1 monkey wrench, 21-inch.

} For use on bruised breechblocks; no other  
files to be used thereon.

## For carriage:

- 1 socket wrench and screw driver for counter-recoil buffer, sight bracket screws, etc.
- 1 wrench for plunger controller and cradle lubricator.
- 1 lifting eye for cradle.
- 1 lifting shackle and pin.
- 1 oiler, one-half pint.
- 1 screw driver for protecting shield-guard screws.
- 1 screw driver for rear compressor plate, etc.
- 1 spanner wrench for rear cylinder, etc.
- 1 wrench for piston-rod nut.
- 1 wrench for spring-guide rod.
- 1 wrench and screw driver for sights and elevating arc.
- 1 filling funnel.

The following being too large, are not to be carried in the chest: Two water buckets, indurated fiber.

## LIST OF IMPLEMENTS FURNISHED FOR 4.72-INCH GUN, ARMSTRONG.

- 1 rammer and staff.
- 1 sponge and staff, bore.
- 1 breech cover.
- 1 combined tomplon and muzzle cover.
- 1 slush brush, with handles to connect with sponge staff.
- 1 steel scraper and socket to fit sponge staff.

LIST OF EQUIPMENT SUPPLIED FOR 4.72-INCH GUN, ARMSTRONG, AND BARBETTE  
CARRIAGE, ARMSTRONG.

- 2 paint pots, 1-gallon.
- 1 sieve for paints and oils.
- 2 brushes, wall, 4 inch.
- 3 sash tools, No. 6.
- 3 brushes, paint, 6/0.
- 2 dusters, painter's, No. 2.

} Expendable.

WAR DEPARTMENT,

OFFICE OF THE CHIEF OF ORDNANCE,  
Washington, January 6, 1911.

October 28, 1904.  
Revised January 30, 1908.  
Revised January 6, 1911.  
Form No. 1750.  
Ed. Aug. 27-17-500.

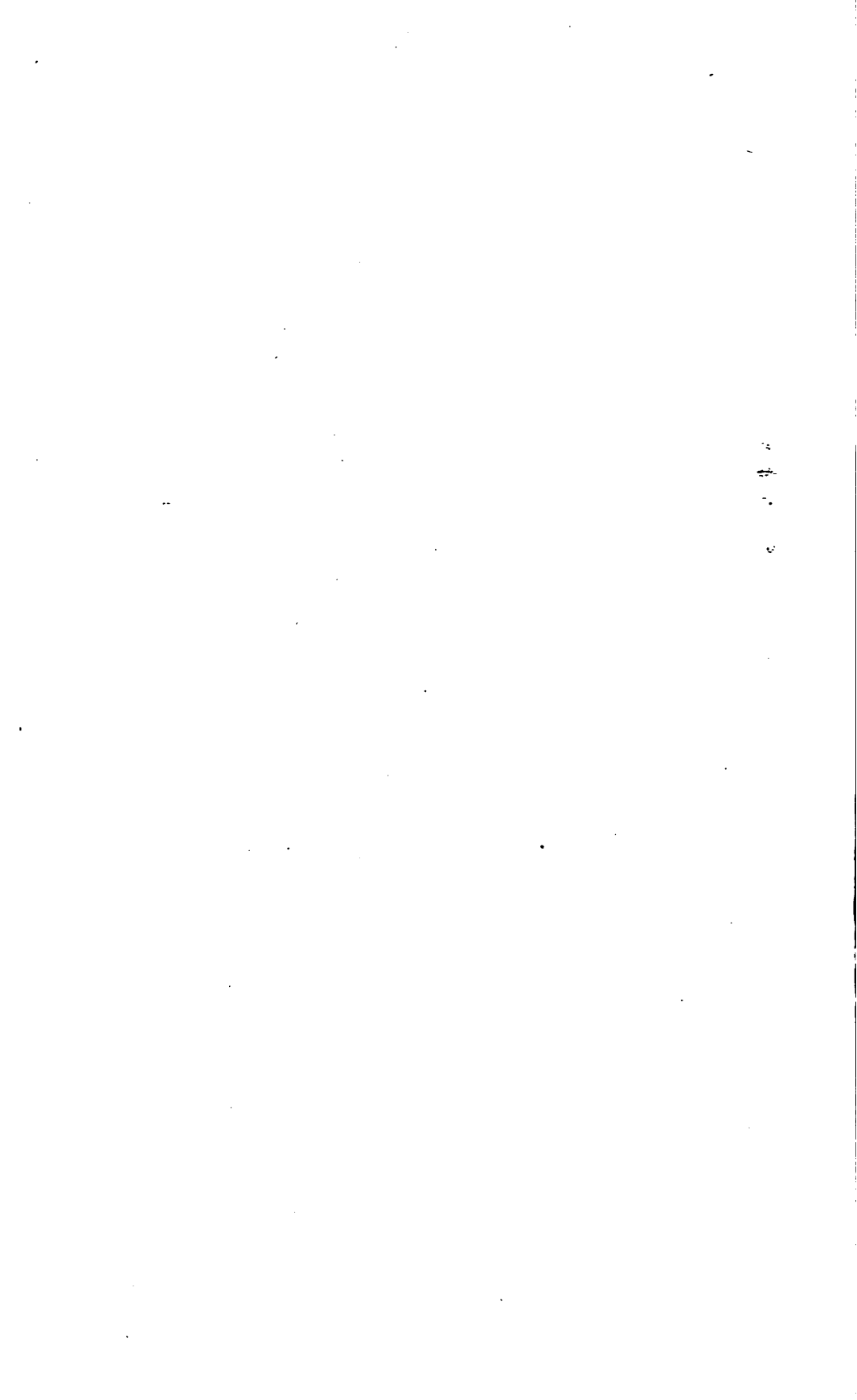
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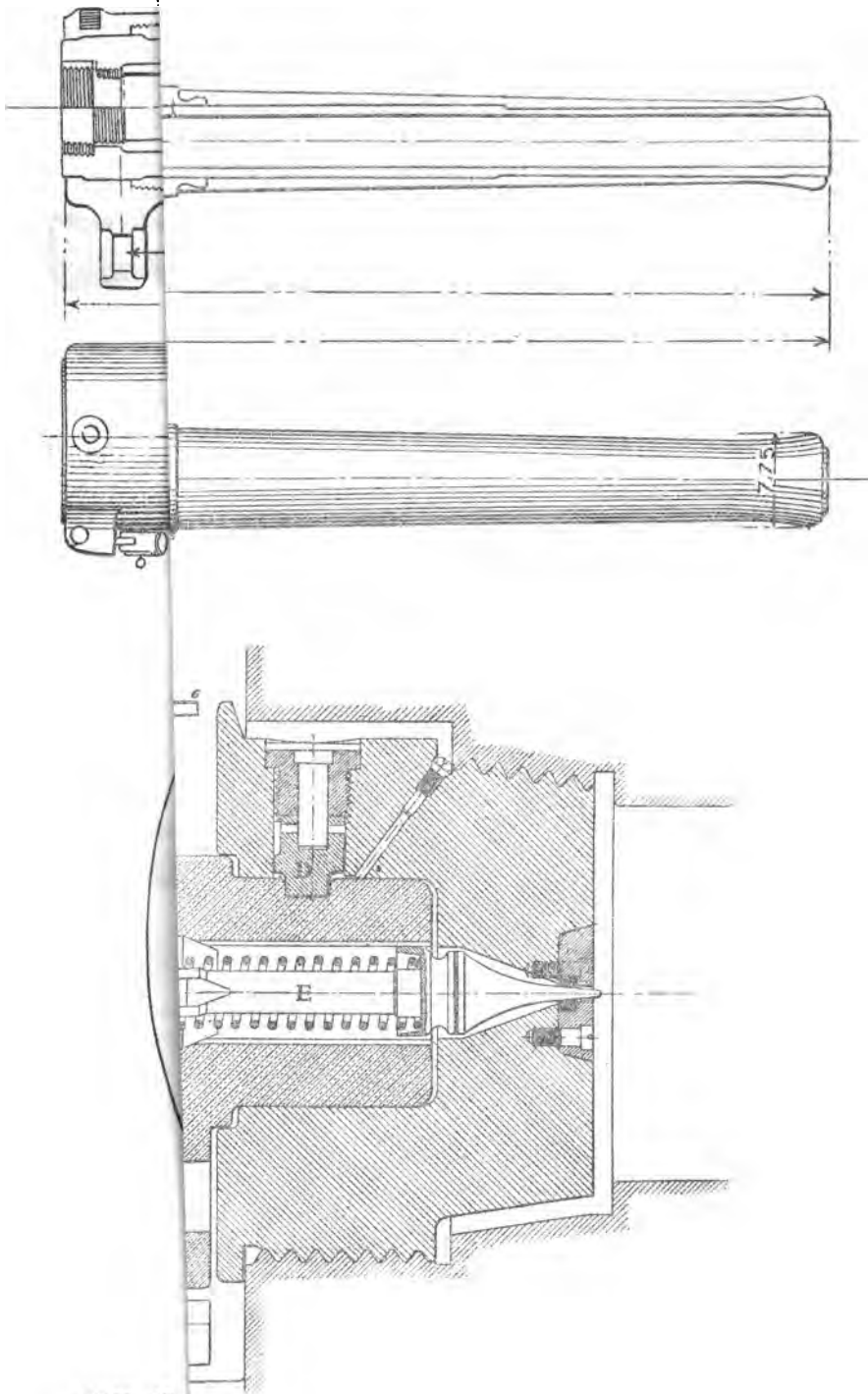
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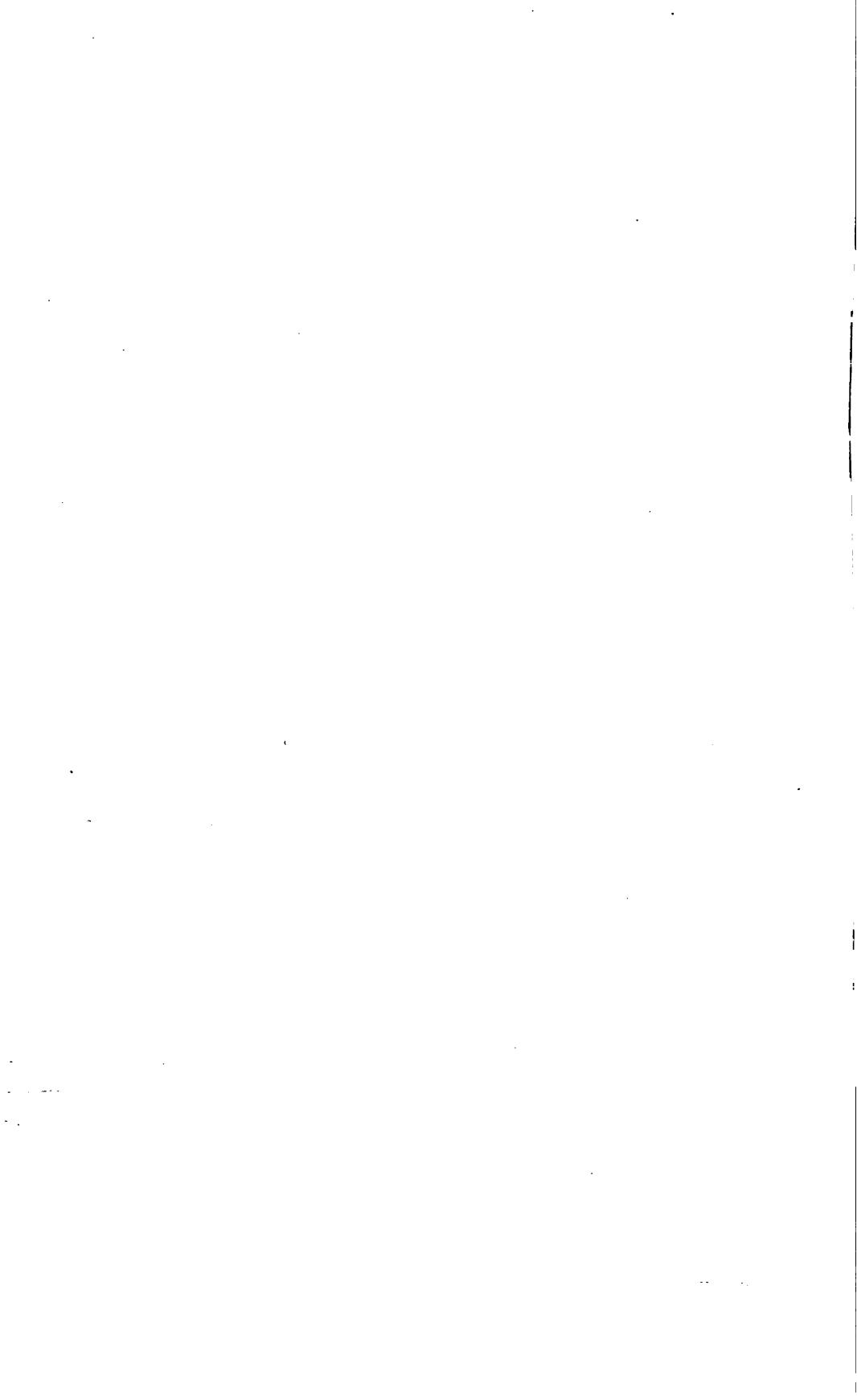
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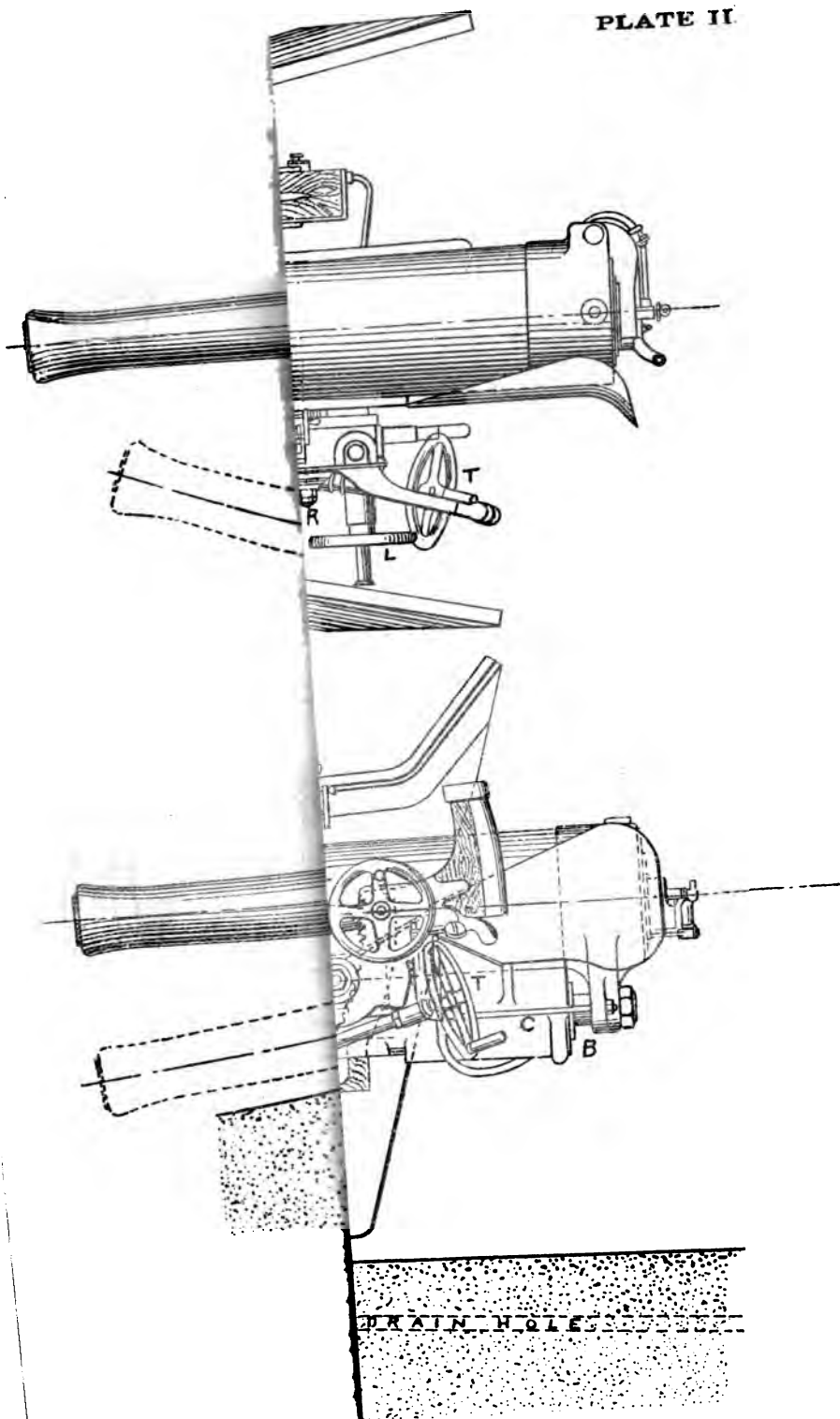
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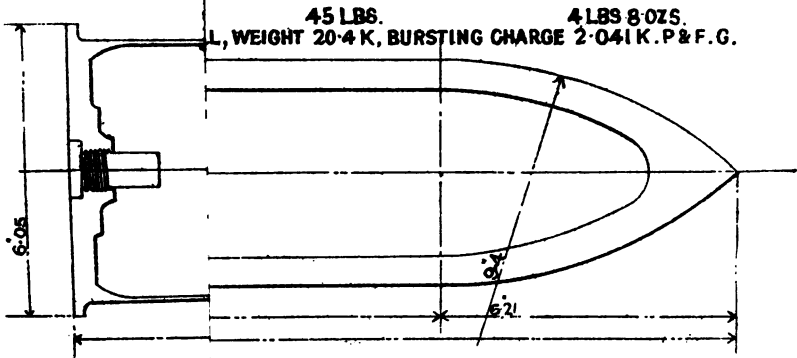






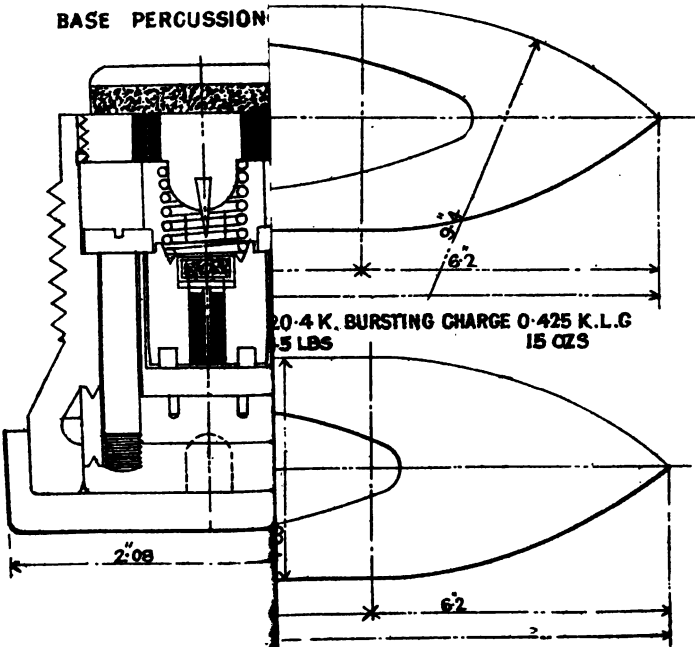


# PLATE III.

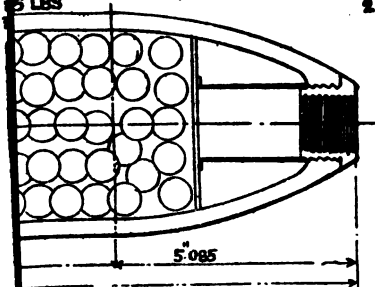


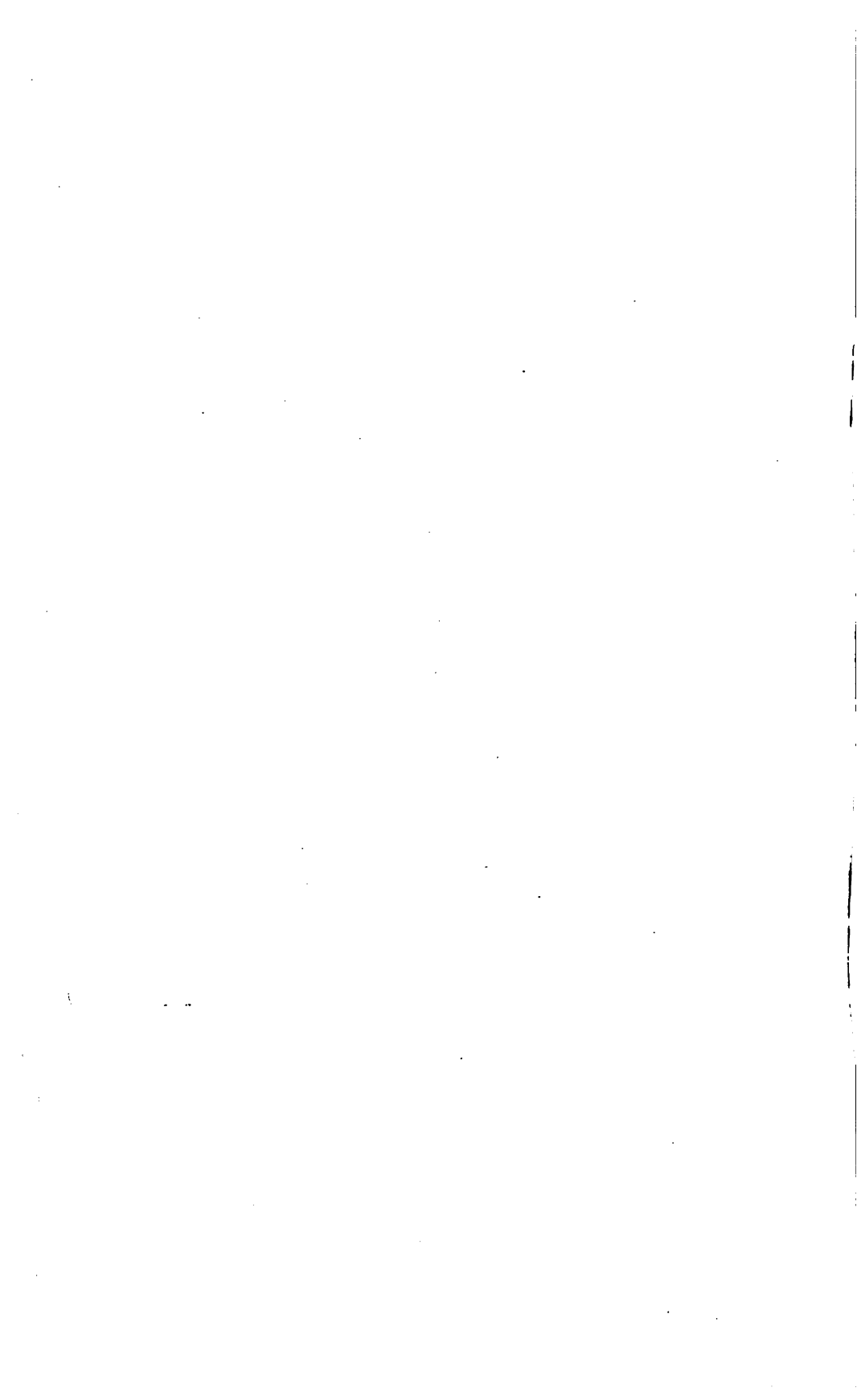
DHT 20.4 K, BURSTING CHARGE 0.907 K. P & F. G.  
4.5 LBS 2 LBS D<sup>s</sup>

## BASE PERCUSSION



20.4 K, 278 BULLETS, BURSTING CHARGE 0.057 K.  
4.5 LBS 2 OZS. L. G.







CASE CAP.  
ONE - FIVE

CONES  
ONE-GLASS



**TWO - ONE RED ONE WHITE**

***ELEC. LIGHT PIN PLUG***

**TW-1480 RUBBER**



**TWO-BRONZE**



**TWO-BRONZE**



**TE LIGHT**



## TWO-EBONIZED WOOD



**BVA BLUE**

**PIN MIT**

## ***FIN WASHER***

## FOUR-BASS

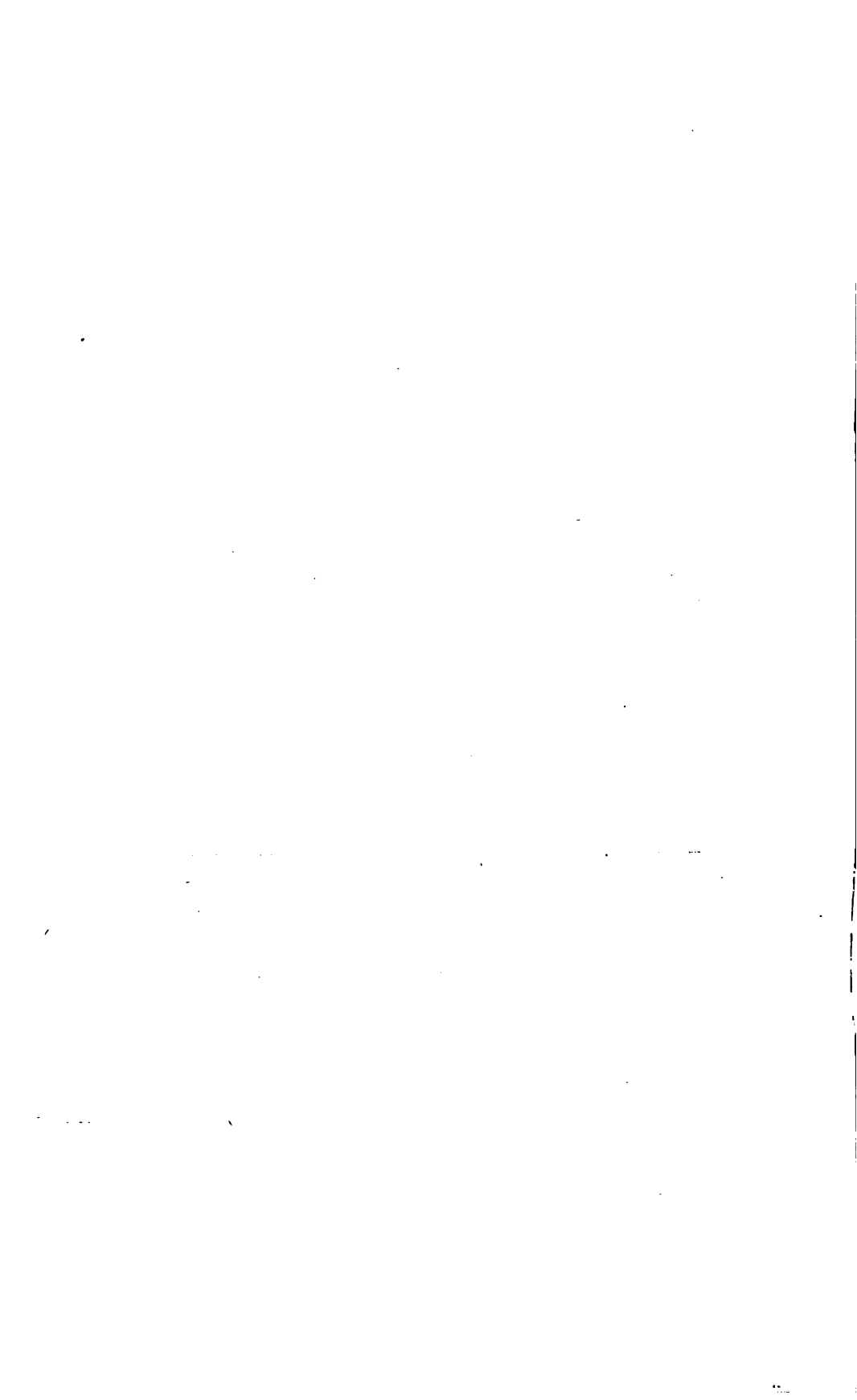


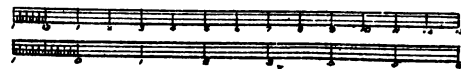
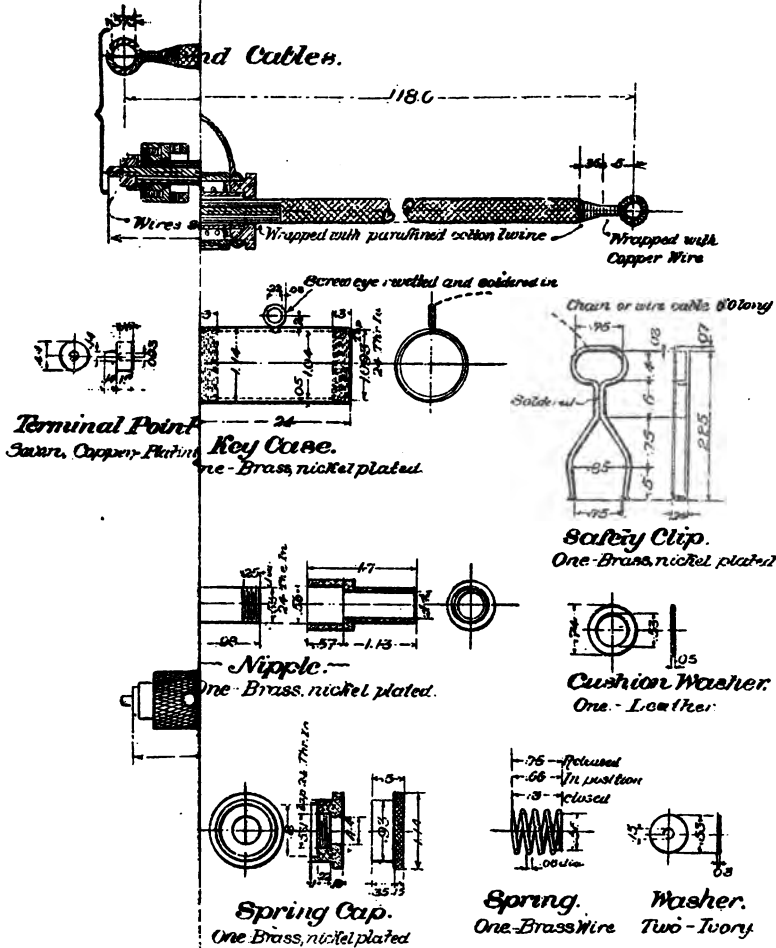
**TE LIGHT**

SOLDER.  
SOFT RUBBER WASHER.  
BRASS WASHER .12 DIAM.  
.04 THICK .22 HOLE.  
23 COPPER WIRES .005 DIAM.  
LENGTH OF CABLE 6 FEET 3 INCHES.  
BRAIDED COTTON

**ALL PARTS FINISHED**

REVISIONS		472 & 6 IN. BARBETTE CARRIAGE, ARMSTRONG	
		DETAILS OF NIGHT SIGHTS	
		WATERLOO ARSENAL U.S.A. JUL 26 <sup>th</sup> 1904	
		S.E.A.	APPROVED
		<i>Wm. H. B. Smith</i> MAJ. ORDNANCE DEPT. COMMAN'DR. G.	BRIGADIER GENERAL CHIEF OF ORDNANCE.
		CLASS 6 DIVISION 1 B	DRAWING 6 FILE

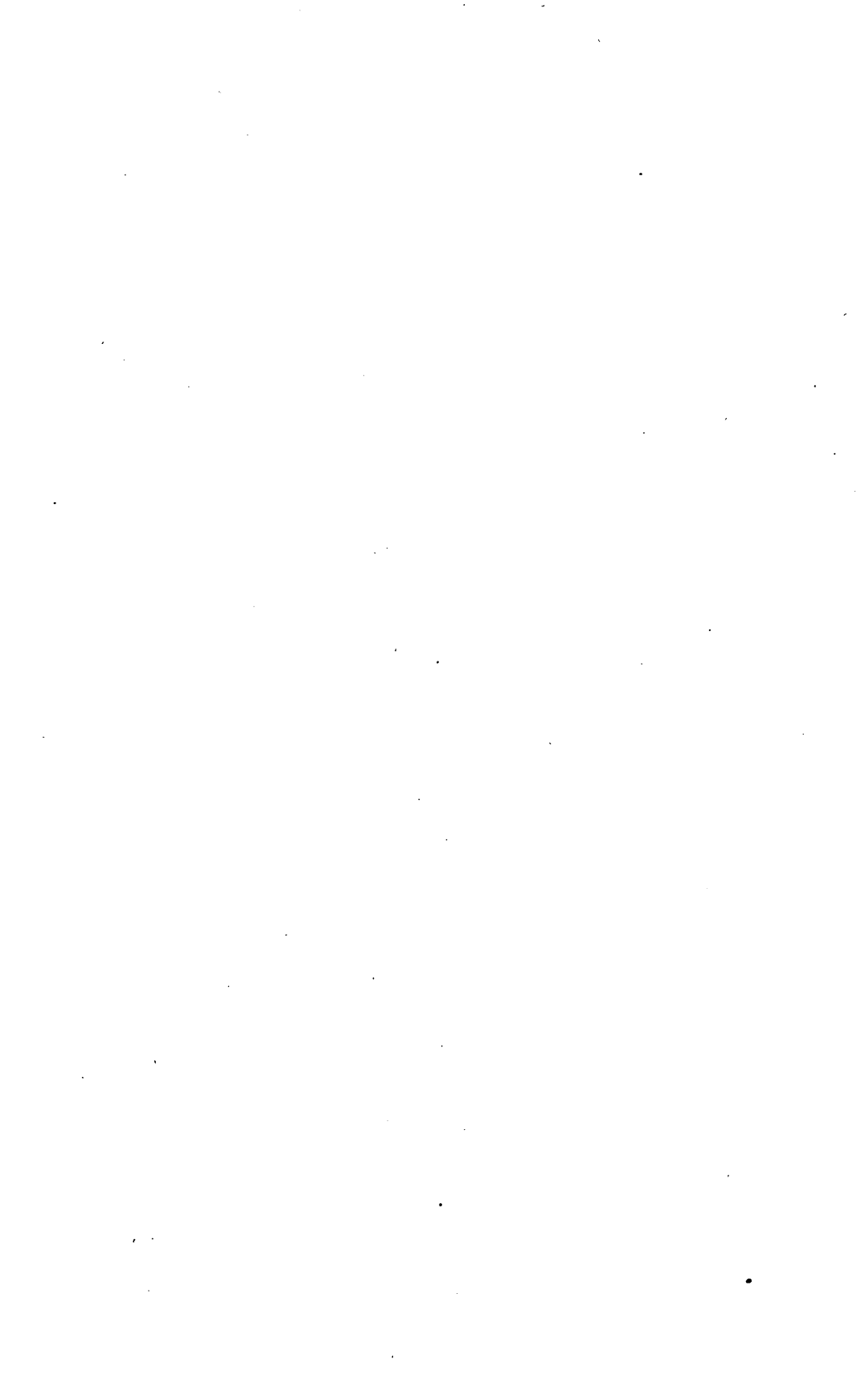




<i>Revisions.</i>	<b>4.7 INCH BARBETTE CARRIAGE</b>
Oct. 29 1902	<b>ARMSTRONG.</b>
Nov. 29 1902	<b>Firing Battery and Cables.</b>
	Watertown Arsenal U. S. A. May 31 <sup>st</sup> 1902
	Approved.
	<i>John H. Borden</i>
	Chief of Ordnance Dept.
	Brigadier General,
	Chief of Ordnance
<b>Class 6</b>	<b>Division 1B</b>
<b>Drawing 2</b>	<b>File</b>



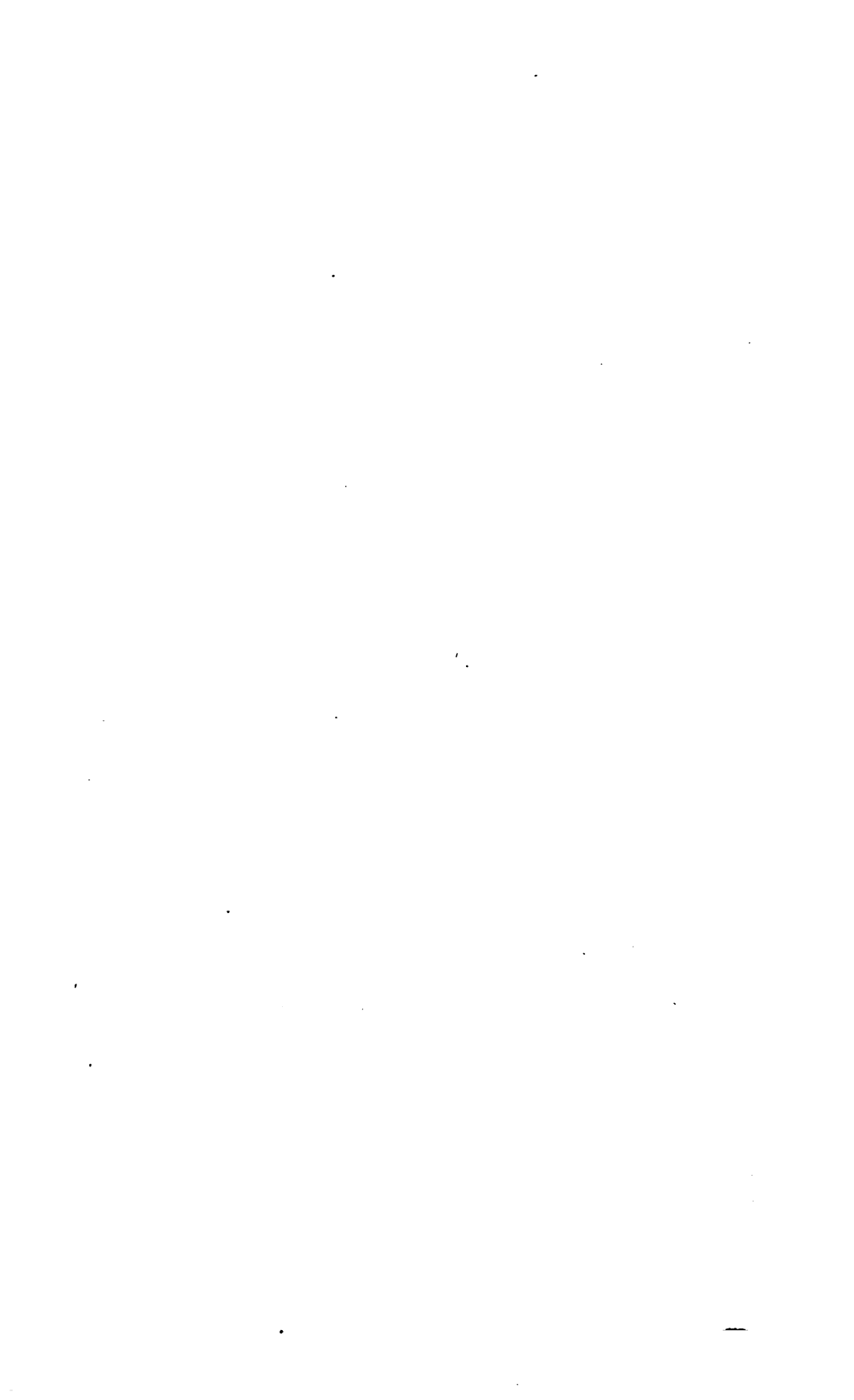













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